

WHAT IS CLAIMED IS:

1. A propylene polymer having:

- (1) a 25°C hexane soluble content (H25) of 0-80 wt%; and,
- (2) either no melting temperature (T_m) measurable by differential scanning calorimetry (DSC), or a melting temperature (T_m) satisfying, if measurable by DSC, the following relationship:

$$\Delta H \geq 3 \times (T_m - 120).$$

wherein ΔH is a melting endotherm (J/g).

2. The propylene polymer according to claim 1, having a fraction (W25) eluted at a temperatures up to 25°C by temperature-programmed chromatography, of from 20-100 wt%.

3. A propylene homopolymer satisfying:

- (1) a mesopentad fraction (mmmm) of 30-60 mol%;
- (2) a racemic pentad fraction (rrrr) satisfying the following relationship:

$$[rrrr/(1-mmmm)] \leq 0.1$$
- (3) a fraction (W25) eluted at a temperatures up to 25°C by temperature-programmed chromatography, of from 20-100 wt%; and,
- (4) a pentad fraction (rmmr) of more than 2.5 mol%.

4. The propylene homopolymer according to claim 3, satisfying the following relationship:

$$(mm) \times (rr)/(mr)^2 \leq 2.0$$

wherein (mm) is a meso triad fraction; (rr) is a racemic triad fraction; and (mr) is a triad fraction.

5. The propylene homopolymer according to claim 3, having a molecular weight distribution (M_w/M_n) of 4 or less as measured by gel permeation chromatography (GPC) and/or an intrinsic viscosity [η] of from 0.5-15.0 dl/g as measured at 135°C in tetralin.

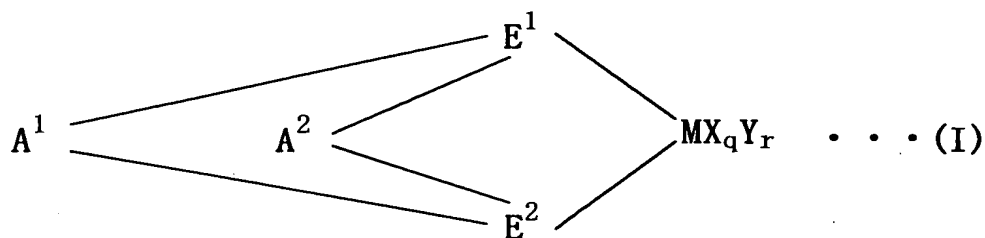
6. A propylene copolymer satisfying:

- (1) a stereoregularity index (P) of 55-90 mol% as determined by ^{13}C -NMR measurement; and
- (2) a fraction (W25) eluted at a temperatures up to 25°C by temperature-programmed chromatography, of from 20-100 wt%.

7. The propylene copolymer according to claim 6 having a molecular weight distribution (Mw/Mn) of 4 or less as measured by gel permeation chromatography (GPC) and/or an intrinsic viscosity $[\eta]$ of from 0.5-15.0 dl/g as measured at 135°C in tetralin.

8. The propylene homopolymer according to claim 3 produced by polymerizing propylene in the presence of a polymerization catalyst containing:

- (A) a transition metal compound represented by the general formula (I):



wherein M is a metal element of Groups 3 to 10 of the Period Table or lanthanoid series;

E^1 and E^2 are respectively a ligand selected from the group consisting of substituted cyclopentadienyl, indenyl, substituted indenyl, heterocyclopentadienyl, substituted heterocyclopentadienyl, amide, phosphide, a hydrocarbon group and a silicon-containing group, which form a cross-linked structure via A^1 and A^2 and may be the same or different;

X is a ligand capable of forming a σ -bond or π -bond with the proviso that when a plurality of X groups are present, these groups may be the same or different, and may be cross-linked with the other X group, E^1 , E^2 or Y;

Y is a Lewis base with the proviso that when a plurality of Y groups are present, these groups may be same or different, and may be cross-linked with the other Y group, E^1 , E^2 or X;

A^1 and A^2 are divalent cross-linking groups capable of bonding the two ligands E^1 and E^2 to each other, are respectively a C_1-C_{20} hydrocarbon group, a C_1-C_{20} halogen-containing hydrocarbon group, a silicon-containing group, a germanium-containing group, a tin-containing group, $-O-$, $-CO-$, $-S-$, $-SO_2-$, $-Se-$, $-NR^1-$, $-PR^1-$, $-P(O)R^1-$, $-BR^1-$ or $-AlR^1-$ wherein R^1 is a hydrogen atom, a halogen atom, a C_1-C_{20} hydrocarbon group or a C_1-C_{20} halogen-containing hydrocarbon group, and may be the same or different;

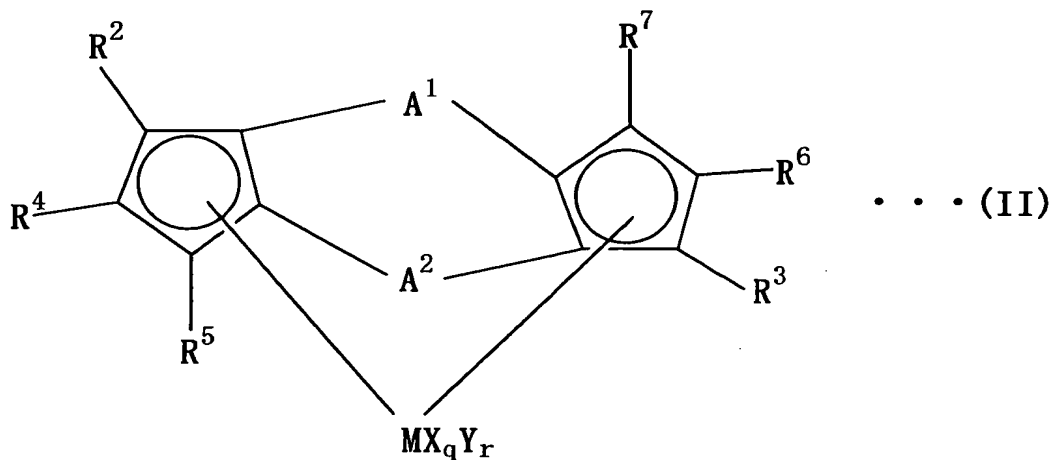
q is an integer of 1 to 5 given by the formula:

$[(\text{valence of } M) \cdot 2]$; and

r is an integer of 0 to 3, and

(B) a component selected from the group consisting of (B-1) a compound capable of forming an ionic complex by reacting with the transition metal compound (A) or a derivative thereof, (B-2) aluminoxane, and (B-3) a Lewis acid.

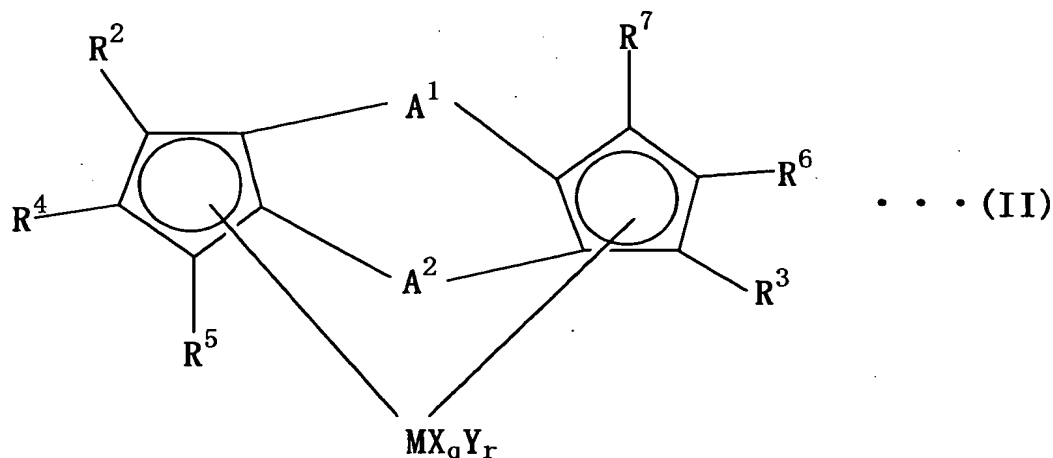
9. The propylene homopolymer according to claim 8, wherein the transition metal compound represented by the general formula (I) is a transition metal compound represented by the general formula (II):



wherein, M , X , Y , A^1 , A^2 , q and r are the same as defined in the above general formula (I); R^2 through R^7 are respectively a hydrogen atom, a halogen atom, a C_1-C_{20} hydrocarbon group, a C_1-C_{20} halogen-containing hydrocarbon group, a silicon-containing group or a heteroatom-containing group with the proviso that at least one of R^2 through R^7 is not a hydrogen

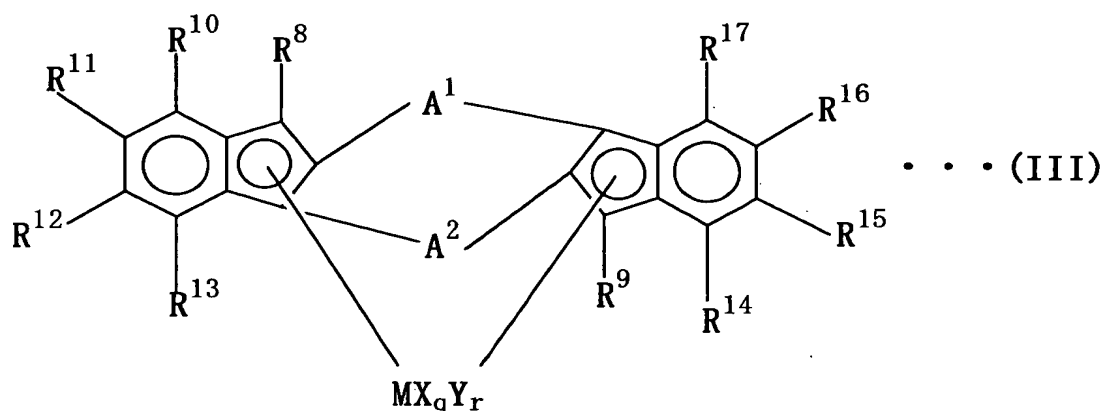
atom; and R^2 through R^7 may be the same or different, and adjacent groups of R^2 through R^7 may be bonded to each other to form a ring.

10. The propylene homopolymer according to claim 8, wherein the transition metal compound represented by the general formula (I) is a transition metal compound represented by the general formula (II):



wherein, M, X, Y, A^1 , A^2 , q and r are the same as defined in the above general formula (I); R^2 through R^7 are respectively a hydrogen atom, a halogen atom, a C_1 - C_{20} hydrocarbon group, a C_1 - C_{20} halogen-containing hydrocarbon group, a silicon-containing group or a heteroatom-containing group with the proviso that at least one of R^2 through R^7 is a group containing a heteroatom such as oxygen, halogen or silicon; and R^2 through R^7 may be the same or different, and adjacent groups of R^2 through R^7 may be bonded to each other to form a ring.

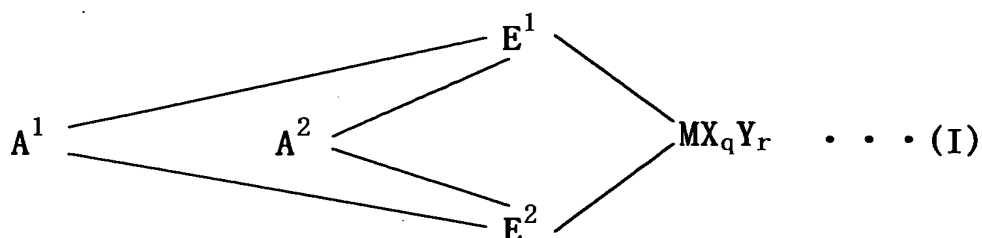
11. The propylene homopolymer according to claim 9, wherein the transition metal compound represented by the general formula (II) is a transition metal compound represented by the general formula (III):



wherein, M, X, Y, A¹, A², q and r are the same as defined in the above general formula (I); at least one of R⁸ and R⁹ represents a group containing a heteroatom such as oxygen, halogen or silicon; and R¹⁰ through R¹⁷ are respectively a hydrogen atom, a C₁-C₂₀ hydrocarbon group, or a group containing a heteroatom such as oxygen, halogen and silicon.

12. The propylene copolymer according to claim 6 produced by copolymerizing propylene with ethylene and/or a C₄-C₂₀ α-olefin in the presence of a polymerization catalyst comprising:

(A) a transition metal compound represented by the general formula (I):



wherein M is a metal element of Groups 3 to 10 of the Period Table or lanthanoid series;

E¹ and E² are respectively a ligand selected from the group consisting of substituted cyclopentadienyl, indenyl, substituted indenyl, heterocyclopentadienyl, substituted heterocyclopentadienyl, amide, phosphide, a hydrocarbon group and a silicon-containing group, which form a cross-linked structure via A¹ and A² and may be the same or different;

X is a ligand capable of forming a σ-bond or π-bond with the proviso

that when a plurality of X groups are present, these groups may be the same or different, and may be cross-linked with the other X group, E¹, E² or Y;

Y is a Lewis base with the proviso that when a plurality of Y groups are present, these groups may be same or different, and may be cross-linked with the other Y group, E¹, E² or X;

A¹ and A² are divalent cross-linking groups capable of bonding the two ligands E¹ and E² to each other, are independently a C₁-C₂₀ hydrocarbon group, a C₁-C₂₀ halogen-containing hydrocarbon group, a silicon-containing group, a germanium-containing group, a tin-containing group, -O-, -CO-, -S-, -SO₂-, -Se-, -NR¹-, -PR¹-, -P(O)R¹-, -BR¹- or -AlR¹- wherein R¹ is a hydrogen atom, a halogen atom, a C₁-C₂₀ hydrocarbon group or a C₁-C₂₀ halogen-containing hydrocarbon group, and may be the same or different;

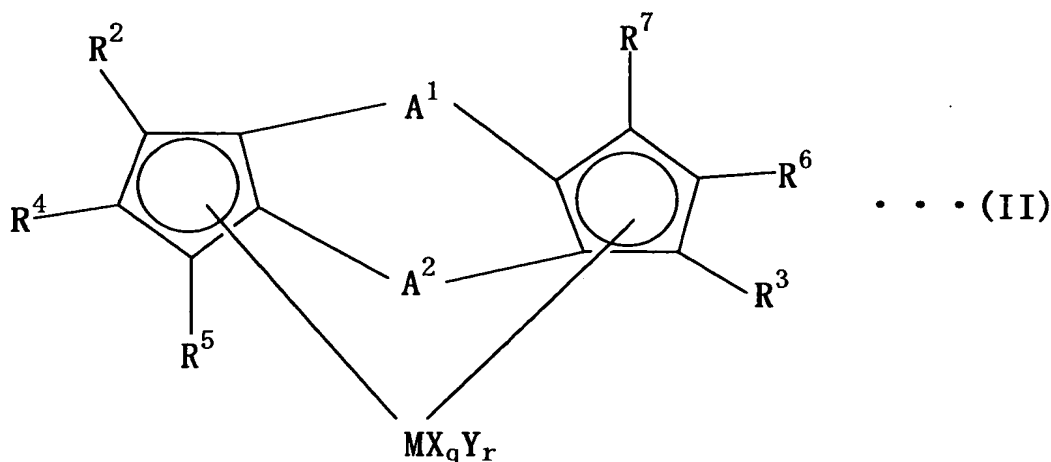
q is an integer of 1 to 5 given by the formula:

[(valence of M) - 2]; and

r is an integer of 0 to 3, and

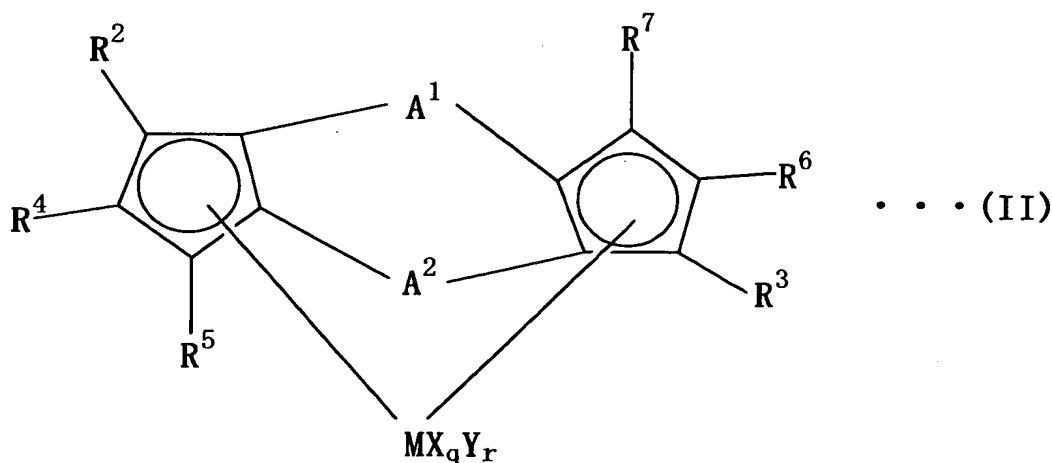
(B) a component selected from the group consisting of (B-1) a compound capable of forming an ionic complex by reacting with the transition metal compound (A) or a derivative thereof, (B-2) aluminoxane, and (B-3) a Lewis acid.

13. The propylene copolymer according to claim 12, wherein the transition metal compound represented by the general formula (I) is a transition metal compound represented by the general formula (II):



wherein, M, X, Y, A¹, A², q and r are the same as defined in the above general formula (I); R² through R⁷ are respectively a hydrogen atom, a halogen atom, a C₁-C₂₀ hydrocarbon group, a C₁-C₂₀ halogen-containing hydrocarbon group, a silicon-containing group or a heteroatom-containing group with the proviso that at least one of R² through R⁷ is not a hydrogen atom; and R² through R⁷ may be the same or different, and adjacent groups of R² through R⁷ may be bonded to each other to form a ring.

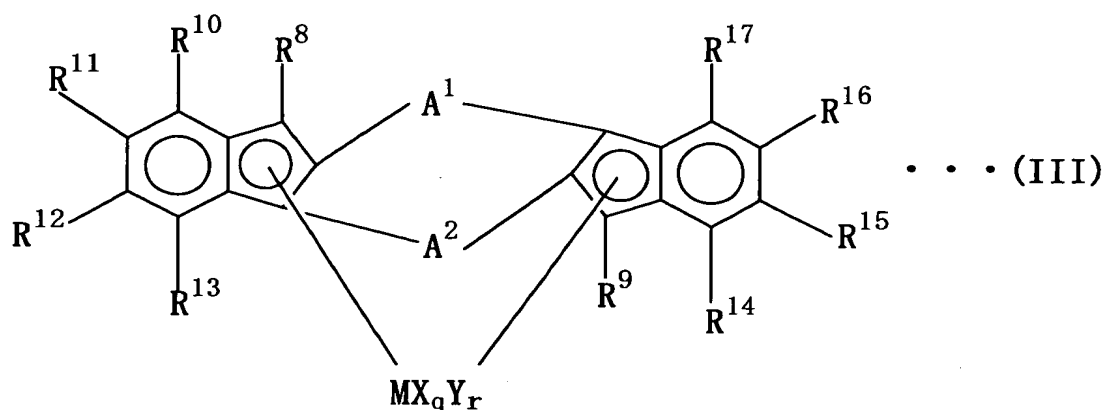
14. The propylene copolymer according to claim 12, wherein the transition metal compound represented by the general formula (I) is a transition metal compound represented by the general formula (II):



wherein, M, X, Y, A¹, A², q and r are the same as defined in the above general formula (I); R² through R⁷ are respectively a hydrogen atom, a

halogen atom, a C_1-C_{20} hydrocarbon group, a C_1-C_{20} halogen-containing hydrocarbon group, a silicon-containing group or a heteroatom-containing group with the proviso that at least one of R^2 through R^7 is a group containing a heteroatom such as oxygen, halogen or silicon; and R^2 through R^7 may be the same or different, and adjacent groups of R^2 through R^7 may be bonded to each other to form a ring.

15. The propylene copolymer according to claim 13, wherein the transition metal compound represented by the general formula (II) is a transition metal compound represented by the general formula (III):



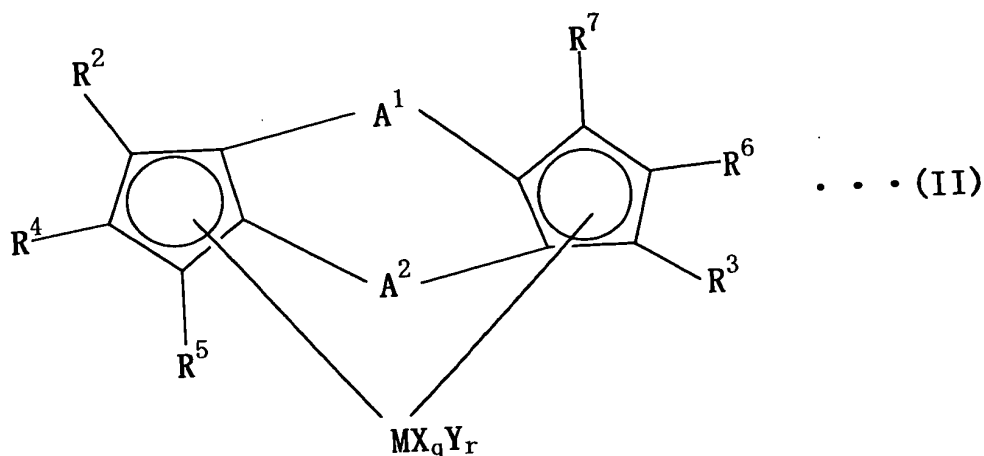
wherein, M, X, Y, A^1 , A^2 , q and r are the same as defined in the above general formula (I); at least one of R^8 and R^9 represents a group containing a heteroatom such as oxygen, halogen or silicon; and R^{10} through R^{17} are respectively a hydrogen atom, a C_1-C_{20} hydrocarbon group, or a group containing a heteroatom such as oxygen, halogen and silicon.

16. A propylene resin composition comprising the propylene polymer according to claim 1 and a nucleating agent.

17. A propylene resin composition comprising the propylene homopolymer according to claim 3 and a nucleating agent.

18. A propylene resin composition comprising the propylene copolymer according to claim 6 and a nucleating agent.

19. A molded product produced by molding the propylene polymer according to claim 1.
20. A molded product produced by molding the propylene resin composition according to claim 16.
21. A molded product produced by molding the propylene homopolymer according to claim 3.
22. A molded product produced by molding the propylene resin composition according to claim 17.
23. A molded product produced by molding the propylene copolymer according to claim 6.
24. A molded product produced by molding the propylene resin composition according to claim 18.
25. A propylene resin modifier comprising the propylene polymer according to claim 1.
26. A propylene resin modifier comprising the propylene homopolymer according to claim 3.
27. A propylene resin modifier comprising the propylene copolymer according to claim 6.
28. A polymerization catalyst comprising:
(A) a transition metal compound represented by the general formula
(II):



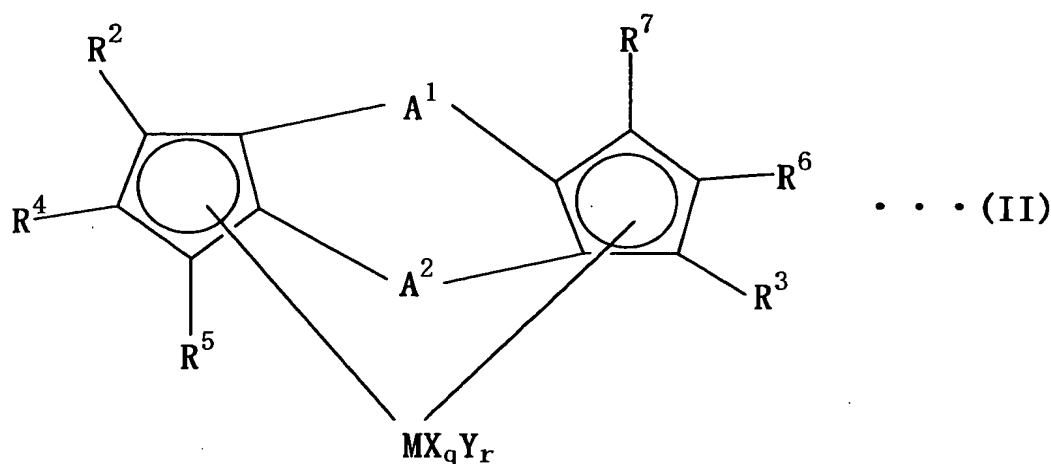
wherein, M, X, Y, A¹, A², q and r are the same as defined in the above general formula (I); R² through R⁷ are respectively a hydrogen atom, a halogen atom, a C₁-C₂₀ hydrocarbon group, a C₁-C₂₀ halogen-containing hydrocarbon group, a silicon-containing group or a heteroatom-containing group with the proviso that at least one of R² through R⁷ is not a hydrogen atom; and R² through R⁷ may be the same or different, and adjacent groups of R² through R⁷ may be bonded to each other to form a ring, and

(B) a component selected from the group consisting of (B-1) a compound capable of forming an ionic complex by reacting with the transition metal compound (A) or a derivative thereof, (B-2) aluminoxane, and (B-3) a Lewis acid.

29. A polymerization catalyst comprising:

(A') a transition metal compound represented by the general formula

(II):

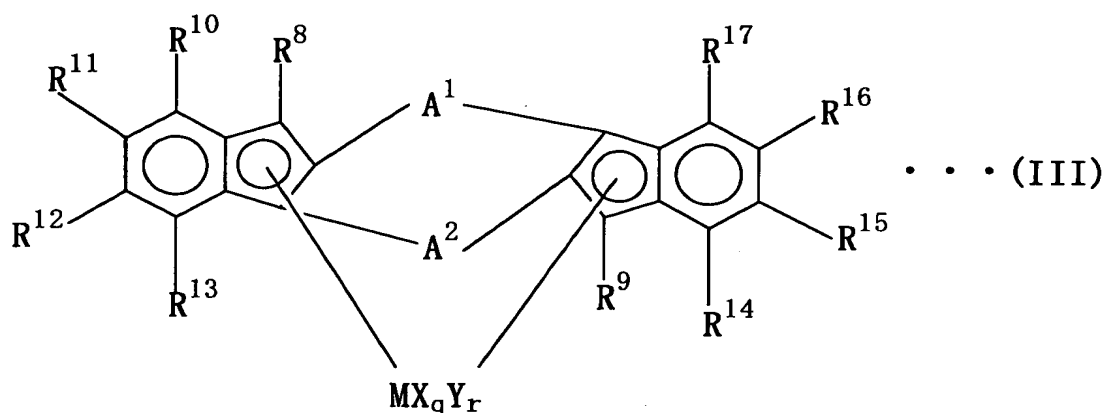


wherein, M, X, Y, A¹, A², q and r are the same as defined in the above general formula (I); R² through R⁷ are respectively a hydrogen atom, a halogen atom, a C₁-C₂₀ hydrocarbon group, a C₁-C₂₀ halogen-containing hydrocarbon group, a silicon-containing group or a heteroatom-containing group with the proviso that at least one of R² through R⁷ is a group containing a heteroatom such as oxygen, halogen or silicon; and R² through R⁷ may be the same or different, and adjacent groups of R² through R⁷ may be bonded to each other to form a ring, and

(B) a component selected from the group consisting of (B-1) a compound capable of forming an ionic complex by reacting with the transition metal compound (A) or a derivative thereof, (B-2) aluminoxane, and (B-3) a Lewis acid.

30. A polymerization catalyst comprising:

(A'') a transition metal compound represented by the general formula (III):



wherein, M, X, Y, A¹, A², q and r are the same as defined in the above general formula (I); at least one of R⁸ and R⁹ represents a group containing a heteroatom such as oxygen, halogen or silicon; and R¹⁰ through R¹⁷ are respectively a hydrogen atom, a C₁-C₂₀ hydrocarbon group, or a group containing a heteroatom such as oxygen, halogen and silicon, and

(B) a component selected from the group consisting of (B-1) a compound capable of forming an ionic complex by reacting with the transition metal compound (A) or a derivative thereof, (B-2) aluminoxane, and (B-3) a Lewis acid.